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The American Biology Teacher

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The Present Status of Instruction in General Biology*

W. EDGAR MARTIN

Office of Education, Federal Security Agency, Washington 25, D. C.

In 1933 the U. S. Office of Education published the report *Instruction in Science*[1] which was based on an analysis of courses of study in the various high school sciences which had been revised since 1925, supplemented by visits to science classrooms. The report of this study gave general information on the following phases of the biology program: objectives of the course, organization of the course, methods of selecting subject-matter, and the instructional techniques used.

In 1942 the Committee on the Teaching of Biology of the Union of American Biological Societies published its report *The Teaching of Biology in the Secondary Schools of the United States.*[2] This report of the results of a questionnaire study on the status of instruction in high school biology during the school year 1939–40; contains the most recent data available in published form on many of the qualitative aspects of this important area of the curriculum.

In 1950 the Office of Education published a report on *The Teaching of Science in Public High Schools*[3] which included information on the enrollment in general biology, some problems related to the course, and new courses in the biological sciences which were offered in a representative sample of the public high schools of the country during the school year 1947–48.

* Text of a paper given at the Annual Convention of the National Association of Biology Teachers held at Cleveland, Ohio, December 28, 1950. (Modified for publication in *The American Biology Teacher.*)

[1] Beauchamp, Wilbur L., *Instruction in Science*, Bulletin 1932, No. 17, Department of the Interior, Office of Education, Washington, D. C., 1933.

[2] Riddle, Oscar, Editor, *The Teaching of Biology in Secondary Schools of the United States*, Union of American Biological Societies, Cold Spring Harbor, New York, 1942.

[3] Johnson, P. G., *The Teaching of Science in Public High Schools*, Bulletin 1950, No. 9, Federal Security Agency, Office of Education, Washington 25, D. C., 1950.

The Office of Education, Federal Security Agency, is now conducting a comprehensive study of instruction in general biology in a representative sampling of the public high schools of the country. In November, 1950, questionnaires were sent to one thousand high schools; regular high schools (grades 9 through 12); combined junior-senior high schools (grades 7 through 12); and senior high schools (grades 10 through 12). This study is the most comprehensive survey of both the quantitative and qualitative aspects of instruction in general biology ever undertaken by the Office of Education.

To date the response to the questionnaire has been very encouraging; approximately 600 completed questionnaires have been returned. In addition to supplying the information requested many teachers have expended considerable time and effort in "writing in" items of information about the course, and some of the problems which they face in teaching the course. These spontaneous reactions furnish clues as to the ways in which instruction in biology is being improved.

The final and official tabulation of the results will not be undertaken until the necessary number of selected schools have reported. A preliminary tabulation of some selected items from the first 115 replies received has been made, however, and the results of these tabulations and analyses form the basis for this report.

Trends in Enrollment in Science Since 1895

The periodic reports made by the Office of Education on offerings and registrations in the public high schools of the country give information on the enrollments in the various science subjects and enrollments in the different years of high school. A summary of the information on the per cent of pupils in the last four years of high school enrolled in the several science courses, including biology, botany, and zoology is given in Table 1 which follows:

TABLE 1

Trends in Enrollment in Science Courses since 1895

Courses	Percentage of total enrollment in last four years of high school									
	1895	1900	1905	1910	1915	1922	1928	1934	1947	1950
									(135 schools in sample)	(115 schools in sample)
Physiology	29.95	27.42	21.96	15.32	9.48	5.08	2.68	1.82	(16)*	(10)*
Agriculture				4.66	7.17	5.11	3.66	3.55	(10)*	(50)*
Zoology				8.02	3.21	1.53	.77	.61	(1)*	(2)*
Botany				16.83	9.14	3.82	1.59	.91	(3)*	(4)*
Biology					6.90	8.78	13.58	14.60	19.51	20.4†
Hygiene and Sanitation						6.06	7.84	6.51	....	(24)*
General Science						18.27	17.50	17.75	18.32	....
Chemistry	9.15	7.72	6.76	6.89	7.38	7.40	7.07	7.56	8.62	....
Physics	22.7	19.04	15.66	14.61	14.23	8.93	6.85	6.27	5.49	....

( )* Number of schools offering the course. Data on pupils enrolled in course not available.
† Enrollment in general biology only. Does not include pupils enrolled in other biology courses.

This shows that biology was first reported as a subject, separate and distinct from botany and zoology, in 1915. In that year a total of 6.90 per cent of the pupils enrolled in the last four years of high school were reported to be taking courses in biology. If the enrollments in zoology and botany are added to that for biology, then a total of 19.25 per cent of the high school pupils were enrolled in these three courses in biological science during that year.

In the 115 schools in the sample analyzed for this report, and covering the school year 1949–50, 40,952 pupils were enrolled in the last four years of high school. A total of 8,357 (20.4 per cent) of these pupils were enrolled in the course in general biology or its equivalent. Information on the number of pupils enrolled in the other courses in biological science which were offered in these schools during 1949–50 is not available. However, the fact that 20.4 per cent of the pupils enrolled in the high schools used in the sample were enrolled in general biology alone, and that many of the larger schools reported from one to four other courses in biological science offered during the same year, would seem to warrant the conclusion that practically all of the pupils entering our high schools take at least one course in biological science during their high school careers. In the vast majority of cases this course is general biology or its equivalent taken in the tenth grade.

For most of those who are not going on to college, this is the last, and possibly the only science course which they will take before leaving our schools to assume the responsibilities of homemakers, voters, and responsible citizens. This fact alone should stimulate many biology teachers to give careful consideration to the content and organization of the courses which they are offering to determine if these courses are meeting the needs and interests of the pupils now enrolled in them.

Furthermore, from other data given in the offerings and registrations reports it is evident that biology is the only science course which has shown consistent increases in enrollment in relation to the general increase in high school enrollments throughout the period for which information is available. All of the other science courses offered in the senior high school years have shown either marked decreases in enrollment, or slight and intermittent increases which are not proportional to the gains in the total enrollment in the schools reporting.

Courses Other Than General Biology Which Are Offered

The extent to which the 115 high schools used in the preliminary analysis were offering instruction in courses in the biological sciences, in addition to general biology, during the school year 1949–50 is shown in Table 2 which follows on page 152.

A total of fourteen different courses were reported by the 115 schools. A separate course in Health, offered either in the Biology Department, or in the Physical Education Department was reported most frequently. Sixty-eight schools (59 per cent) reported that instruction in separate courses in Health were offered from a minimum of one semester during the four years of high school, to a maximum of every semester throughout these years.

According to the comments of teachers written in on the questionnaire, the course in Advanced Biology offered in seven schools in the eleventh or twelfth grades has been added to the curriculum in some of these schools to meet the needs of general education pupils for a terminal course preparing them for more

TABLE 2

Courses other than General Biology Offered in 1949–50

Courses offered	Total schools offering		Schools with enrollment of			
	Number	Percent	1–99	100–299	300–499	500 and over
Health	68	59.0	10	26	19	13
Agriculture	50	43.5	10	20	12	8
Hygiene	24	20.8	5	9	7	3
Physiology	10	8.65	0	4	3	3
Advanced Biology	7	6.0	1	5	0	3
Nature Study	6	5.2	1	4	0	1
Botany	4	3.5	1	0	3	0
Conservation	3	2.6	0	1	0	2
General Science*	3	2.6	1	1	1	0
Zoology	2	1.74	0	0	2	0
Nursing Preparation	1	.8	1	0	0	0
Home Economics	1	.8	0	1	0	0
Home Nursing	1	.8	0	1	0	0
Earth Science	1	.8	0	0	0	1

*Exclusive of 9th grade General Science.

effective home and family living, and for more intelligent participation in our democratic society. In other schools the course gives specialized training for college and the professions.

Offerings and Requirements in General Biology

It has long been assumed that general biology is a tenth-grade subject, but the evidence for this assumption, and information on the extent to which it is a required course, has not been readily available.

Table 3 gives data on these two points:

In the 115 schools reporting, 104 (90 per cent), offer the course in the tenth grade; 6 schools (5.2 per cent) offer it in the ninth grade; and 5 schools (4.35 per cent) offer it in grades 11 or 12. Most of these schools indicate that the course is open to pupils from other high school grades and to post-graduate students.

A total of 43 schools (37.2 per cent) report that the course in general biology is required of all pupils. In the majority of these schools the course is offered in the tenth grade, but it is open to pupils from the other grades to take care of

TABLE 3

Offerings and Requirements in General Biology, 1949–50

Size of school	Total schools in sample	Number of schools offering course in			Number of schools		
		Grade 9	Grade 10	Grades 11 and 12	Requiring course of all pupils	Requiring course in some curricula	Not requiring the course
1–99 pupils	21	1	18	2	12	3	6
100–299 pupils	39	4	34	1	14	6	19
300–499 pupils	26	1	25	0	12	5	9
500 and over	29	0	27	2	5	8	16
Total	115	6 (5.2)%	104 (90.0)%	5 (4.35)%	43 (37.2)%	22 (19.1)%	50 (43.5)%

those pupils who have transferred from other schools.

Twenty-two schools (19.1 per cent) report that the course is required in some curricula; and 50 schools (43.5 per cent), offer the course as an elective only.

The Organization of the Course

None of the studies previously reported has attempted to secure specific information to how the course in general biology is organized for instructional purposes in a representative sample of the high schools of the country.

This preliminary analysis shows that the organization of the course which occurs most frequently is that based on principles related to the whole field of biology, reported by 84 schools (73 per cent). Eighteen schools (1.5 per cent) report that their course is based on specialized treatments of botany and zoology; while twelve schools (1.04 per cent) report that it is based on topics selected for their importance in daily living without reference to the field of biology.

Areas (Topics) Emphasized in the Course

Critics of the course in general biology as taught in our high schools today have usually maintained that it is a traditional course following very closely the pattern of the course or courses in biology which the teachers took in their college training. This criticism is not supported by the data secured in this analysis. In response to the question on the topics which were emphasized in the course, the schools responded as follows:

TABLE 4

Areas (Topics) Emphasized in General Biology

Areas emphasized	Total schools reporting		Range of instructional time in days		
	Number	Percent	Minimum	Maximum	Average
Schools reporting areas	93	100.0	....	....	....
Genetics, Heredity and Race	79	84.0	5	50	17.7
Conservation	77	82.5	5	90	18.6
Health	71	76.5	10	120	36.5
Classification	61	65.5	2	95	28.2
Human Biology	37	39.9	10	45	31.0
Plant Biology	30	32.4	15	90	37.0
Animal Biology	23	24.8	15	90	42.5
Reproduction (Sex Education)	22	23.6	3	40	21.5
Behavior (Psychology)	24	25.8	8	45	18.9
Foods and Nutrition	17	18.3	3	46	28.6
Disease Control	15	16.25	3	40	18.9
Adaptations and Evolution	8	8.5	5	20	13.5
Ecology	5	5.4	12	30	17.4

The three topics reported most frequently were: Genetics and Heredity; Conservation; and Health; reported by 79, 77, and 71 schools respectively. There is considerable evidence to show that these areas are not emphasized in the college courses usually taken by teachers in their pre-service training.

Classification as a topic of emphasis was reported by 61 schools (65.5 per cent). This might appear to be one of the emphases which has carried over

from college classes. However this conclusion is not justified if the qualifying remarks of the teachers answering this question area taken into account. Many of them suggested that Classification was not the category which would characterize their work in this area since the emphasis was not on taxonomy and technical nomenclature, but rather, on giving an overview of the kinds and characteristics of living plants and animals of the world with special emphasis on those occurring locally, and on their economic importance.

Use of a Basic Textbook

A total of 91 schools (80 per cent) reported that a basic textbook was used in the course and 73 schools (64.5 per cent) reported that the basic text was followed in the instruction. Twenty-four schools (21 per cent) indicated that a basic text was not used in the course. A majority of these schools reported that they were using several texts along with magazines, and industry-prepared and supplementary materials of various types. Relatively few of the schools were using a classroom library, they depended on the school library as the center where these materials were available for use by the pupils.

Nature of the Laboratory Work

The extent to which laboratory work is used in the instruction in general biology, and the nature of the experiences which pupils have in the biology laboratory have been questionable areas for many years. Table 5 which follows shows what the schools reported about the nature of the laboratory work and the time devoted to it.

TABLE 5

Nature of Laboratory Work—Method of Scheduling and Percentage of Time

Laboratory work	Total schools reporting		Schools with enrollment of			
	Number	Percent	1–99 pupils	100–299 pupils	300–499 pupils	500 and over
Offering laboratory work	94	100.0	14	27	25	28
Single periods only	75	79.7	12	20	20	23
Double periods	19	20.2	2	7	5	5
With flexible lab. schedule	29	30.9	5	14	3	7
With integrated lab.-recit. periods	45	48.0	8	12	12	13
Not offering laboratory work—or not supplying data	21	....	7	12	1	1
Average percentage of time to lab. work	24.84		22.75	25.2	24.9	26.5
Range of percentage of time to lab. work	4-80		10-50	5-80	4-75	5-50

Ninety-four of the 115 schools (81.6 per cent) reported that laboratory work was used in the course, and gave information on the nature of the work. Of these schools 75 (79.7 per cent) offer laboratory work in single periods only, while 19 schools (16.5 per cent) report that the laboratory work is offered in one or two regularly scheduled double periods each week. A flexible laboratory

schedule, i.e., laboratory work given at no scheduled period during the week was reported by 29 schools (25.6 per cent) while the use of integrated laboratory-recitation periods, i.e., laboratory work used as needed in the attack on problems, etc., was reported by 45 schools (39 per cent).

The average percentage of the total instructional time devoted to laboratory work in all schools was 24.84 per cent, with a range from a minimum of 4 per cent reported by one school to a maximum of 80 per cent reported by another school.

Only three schools (2.6 per cent) reported that laboratory work was not used in the instruction.

"The use of pupil-teacher planned experiments," was reported by 37 schools (33 per cent) as being the laboratory procedure used most frequently. "Performing the experiments in a manual or workbook," was reported by 33 schools (29.4 per cent); "following a course of study and using teacher-guides," was reported by 18 schools (16.2 per cent); "performing only the experiments, etc., in the textbook," was reported by 5 schools (4.45 per cent); and "using experiments, etc., which are planned and carried out by pupils in problem-solving situations," was reported by 5 schools (4.45 per cent).

The kinds of laboratory activities used most frequently were as follows: "Small groups perform experiments, etc.," reported by 34 schools, 30 per cent of all the schools using laboratory work in the instruction; "pupils paired for experiments," reported by 28 schools (24.6 per cent); "individual experiments," reported by 21 schools (18.4 per cent); "teacher demonstrations only," reported by 16 schools (14.2 per cent); "pupil demonstrations," reported by 5 schools (4.45 per cent) and "pupil observations in the classroom," reported by 5 schools (4.45 per cent).

Use of Microscopes

A total of 111 schools out of the 115 reported that one or more microscopes were available for use in the general biology classes. Several of the schools reporting a small number of microscopes indicated that a microprojector, a bioscope, or a similar instrument was available and regularly used in the instruction. Only four of the 115 schools reported that a microscope, or a microprojector, was not available and these schools were not using laboratory work in the instruction.

Use of Supplementary Aids

In response to the question regarding the changes or innovations made in the last five years many schools reported "Setting up a projection room and purchasing audio-visual and other supplementary aids," as being the most important change. That these supplementary aids are being used regularly in the instruction is borne out by the responses from these schools. Only one school out of 115 reported that supplementary aids were not regularly used. The aids which are used regularly by more than 70 per cent of the schools are: charts, preserved specimens, motion pictures, microscope slides, posters and pictures, film strips, and living specimens.

The disquieting thing is that "living specimens" are reported as being regularly used in the general biology classes in only 84 schools (74.5 per cent).

Use of Field Trips

It goes almost without saying that well-planned field trips are essential in a functional course in general biology.

Yet a total of 25 schools, 21.8 per cent, reported that no field trips were taken during the year. The reasons given for not taking field trips in the larger schools were: that they were located in congested areas with no suitable areas readily accessible, or that the daily schedule of classes was so rigid that no time over and above the regular class time could be used for trips. Several small rural schools reported that they did not take field trips because they were located in rural areas and the children were well acquainted with the common living things of their region so that there was no need to use school time for trips. A few schools reported that the inclement weather of their region did not permit field trips to be taken regularly. Some schools listed administrative or parental objections to field trips, and others cited legal responsibilities placed upon the teacher conducting the trip as reasons for not taking trips. A total of 90 schools (78 per cent) reported that field trips were taken regularly. The average number of trips taken per year by these schools was 5.6; the range was from a minimum of 1 trip reported by one school, to a maximum of 20 trips per year reported by two schools.

The most popular season for field trips is spring. The least popular is winter. This is true even in schools in the Southern States where field trips can be taken in winter.

Science Clubs

According to information given in the Riddle study on the extent to which biology clubs were being used in the schools in 1939–40, out of the 3186 replies analyzed a total of 1680 schools (52.7 per cent) reported that one or more biological clubs—Science, Nature Study, Bird Study, Biology—were operating in each of these schools. A total of 1886 clubs with these special designations (in addition to clubs bearing other names) were reported by the 1680 schools. Only 245 schools (7.7 per cent) reported that they had no such clubs. That something serious has happened to these "extracurricular" activities in the intervening ten years, is evident, if the results of the preliminary analysis, here reported, are typical for all schools of the country in 1949–50.

A total of 84 schools (73 per cent) reported that they had no science clubs. The reasons given most frequently for not having a club were: "teachers lack time" and "a transportation problem,—pupils are transported by bus and have to leave immediately after classes are over." Many schools reported that they had no science clubs because the pupils were already involved in too many activities. Several of the larger high schools reported that until a few years ago they had very active club programs, but that in the last few years teacher-load in these schools had increased to such an extent that clubs had to be dropped. Science clubs are practically non-existent in small high schools with enrollment below 100 pupils.

A total of 31 schools (27 per cent) reported that they had from one to ten science clubs. The majority of these schools have only one club enrolling all pupils in the school who have an interest in science. The club which ranks second in popularity is the Photography, or Camera Club. Relatively few schools report a club which is exclusively "biological" in nature.

Summary

In general it appears that it is the large high school located in a congested area which exhibits a rather consistent

pattern of critical problems relating to the teaching of general biology.

This is the type of school which reports the largest classes in biology, and the heaviest teacher load. It is the type of school which reports most frequently that it is not using field trips to supplement the classroom instruction because of difficulties in scheduling such trips or because of the inaccessibility of suitable areas for such trips. It is also the type of school which is likely to report that no science clubs are available to the pupils because the teachers do not have the time to organize and conduct such clubs.

This combination of problems faced by these large high schools, which enroll more than 50 per cent of the youth of high school age in our country, seems to warrant the earnest consideration of administrators and teachers if the instruction in biology is to become functional in the lives of the pupils attending these schools.

It should be emphasized that the information on the status of the selected phases of instruction in biology as described in this report is tentative and incomplete. It is valid only for the first 115 reports received and represents an incomplete return of the sample which was planned for this study. The necessary additional returns will be sought in the next month. Plans are now in progress for a careful tabulation of all the returns. The full report of the study should be available to teachers and administrators in the Spring of 1952.

Don't miss the Annual Joint Field Trip of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS and THE AMERICAN NATURE STUDY SOCIETY which will start at 8:00 A.M., Sunday, December 30, from the Adelphia Hotel. See details of the trip on page 163.

SPICES HELP PRESERVE FOODS

That spices help prevent the deterioration of fats in food, a fact suspected for centuries but never before verified by modern science, has been proved by studies made at the Hormel Institute of the University of Minnesota, according to a report issued by the university.

Seventy-seven samples representing 32 spices were tested, with the result that, "Virtually all samples tested showed at least some antioxidant activity; in a few cases, the antioxidant effects were very pronounced."

Several studies have been made on the properties of spices in preventing food spoilage caused by microorganisms, but this is the first made on the prevention of retarding of the oxidation of fats in food. The Hormel Institute study tested the effect of passing oxygen through steam-treated lard in which ground spices of the same concentration had been mixed, and compared the results with the deterioration in lard to which no spices had been added.

It was discovered that there is little difference between the antioxidant properties of a spice no matter where it is grown. In other words, nutmegs grown in the West Indies have the same antioxidant index as nutmegs grown in the East Indies.

Additional studies will be made at the Institute to isolate, identify and further evaluate the substances in spices which are useful as antioxidants in fats and food products, ". . . not only to elucidate the nature of the antioxidant effect of the spices, but to determine whether it would be feasible to prepare the antioxidants using the natural spices as source materials."

All lard samples to which spices had been added had an index above one, which means that they were less subject to oxidation than the lard to which no spices had been added. Four samples representing two spices had an antioxidant index more than four times that of fat to which no spice had been added.

PHILADELPHIA MEETING

Thursday Morning, December 27, 1951

8:00 A.M. Coral Lotus Room, Adelphia Hotel; Meeting of Board of Directors.

9:00 A.M. Crystal Room, Adelphia Hotel; Preview of Biology films arranged by NABT, Harvey Stork, Presiding.

10:00 A.M. Crystal Room, Adelphia Hotel; Joint Session of Science Teaching Societies affiliated with AAAS (Planned by NABT).

Richard L. Weaver, Presiding; Introduction to Three Joint Sessions.

Address

Rose Lammel, Adapting the Science Curriculum to the Developmental Needs and Interests of Children.

Discussion Groups

Each group will have an opportunity to discuss the above topic.

Discussion Group Leaders

1. Arthur Baker
2. J. Darrell Bernard
3. Ned Bingham
4. Glenn O. Blough
5. Robert Carleton
6. Lydia Elzey
7. Leo Hadsall
8. Ruth Hopson
9. Elizabeth A. Huntington
10. Phillip G. Johnson
11. Marcella R. Lawler
12. Betty Lockwood Wheeler
13. N. L. Palmer
14. Lily A. Weirbach
15. Prevo Whitaker

Thursday Afternoon, December 27

Jefferson Room, Hotel Adelphia.

Harvey E. Stork, Presiding.

2:00 P.M. Dean B. B. Harris, Continuity of the Biology Program through the elementary schools, high school, and college.

Panel discussion on Continuity of the Biology Programs.

Harold F. Bernhardt, Moderator
Gertrude Eldridge, Elementary Schools
Luella Clayton, Junior High School
Thomas H. Knapp, Senior High School
Robert B. Gordon, College

Thursday Evening, December 27

6:30 P.M. Buffet Supper, North Garden, Hotel Adelphia.

10:00 P.M. All—Societies Mixer.

Friday Morning, December 28

8:00 A.M. Coral Lotus Room, Adelphia Hotel: Meeting of NABT Conservation Project Committee.

9:00 A.M. Crystal Room, Adelphia Hotel. Preview of Natural History Films. Arranged by ANSS, Ellsworth Jaeger, Presiding.

10:00 A.M. Joint Session of Science Teaching Societies affiliated with AAAS (Arranged by ANSS): Adapting Science Instruction to meet Community needs.

Richard W. Westwood, Presiding.

Panel

1. Eckert, T.—Cooperative Planning by Teacher's Colleges.
2. Weaver, Mrs. R. L.—Using the Group-Unit Method Democratically.
3. Keinholz, R.—A Nation-wide Study of Community Problems.
4. Jeager, E.—Tepee Camporee.
5. Weaver, R. L.—Tar Heel Family.

Friday Afternoon, December 28

12:30 P.M. NABT Luncheon, Jefferson Room, Adelphia Hotel, Richard L. Weaver, Presiding. The Past Presidents of the Society will be honored.

(Continued on page 166)

Suggestions for the Teaching of Ecology

RALPH W. DEXTER
Kent State University, Kent, Ohio

In recent years increasing interest in the science of ecology has been shown in the development of new teaching programs, curricula, and textbooks. In some instances emphasis has been placed upon the role of ecology in its relation to the whole field of biology as it has never been given before. More and more the new textbooks are giving stress to ecology, and several weave the thread of ecology throughout the text. There is need on the part of teachers to become more familiar with the teaching methods of this subject and to give more emphasis to an ecological point of view. In this paper the writer will briefly describe techniques which he has found successful over a period of twelve years in teaching ecology courses. While my experience has been at the college level, the techniques herein outlined can be modified and used successfully at a wide range of educational levels. Ecology is now a part of biological education from nature study in the elementary grades through each successive level to graduate school. The writer has already shown in the pages of this journal the unification of the natural sciences through the study of ecology, and has outlined the various phases of this science (Dexter 1945a, 1946a). This paper will continue the earlier discussions with the presentation of specific teaching methods.

I. Field Studies

All studies in ecology are based upon field work, either directly or indirectly. Without question the actual field observation is the essence of this science. Guidance for planning and conducting field trips is given in detail by Adams (1942), and a general discussion on conducting field trips has been published by the writer (Dexter 1943a) in which the aims, objectives, and general procedures of conducting field trips are outlined. Topics for specific studies are suggested here.

The most obvious problem which is first met in the field is that of community composition and structure. Whether one is observing a coniferous forest, deciduous forest, grassland, desert, or some other type of community, it becomes clear at once that it has a distinctive composition of plants and animals and has a definite structure which may be analyzed. The first step is to measure the physical factors of the environment in which the community is existing: temperature, humidity, and pH, are among the factors which can be measured easily and quickly. Others can be included if more complicated instruments are available. The plant and animal constituents and their stratification can be determined by sampling techniques. With the information on physical measurements, which may be supplemented with weather station data, geological and soil maps, as well as general observations, correlations may be made between environmental factors and the stratification of the plants and animals. Ecology offers an excellent opportunity for the integration of the physical and biological sciences. In addition to the macro-communities, similar studies may be made upon microhabitats and their communities such as those of fallen logs and temporary pools.

Following the study of community composition and structure, its relationship to the process of succession should

be determined. Wide experience in a given region will soon make clear the climax type for that region, and observations will disclose the general relationship of a particular community to the successional series. Many field trips can be organized around a successional sequence such as open bog lake, closed bog, bog forest, and climax forest to trace a hydrosere as well as to study the structure of specific types of communities. Secondary successions such as found in abandoned pastures and fields with concentric zones of open field vegetation, tall weeds, blackberry brambles, sumac shrubs, aspen-sassafras grove, and hardwood forest are easy to find and illustrate the principles of succession fully as well as the primary seres which are not always available within a reasonable travel distance.

Seasonal aspection excites much interest when field trips are made at different times of the year. With the seasonal change of environment and community structures such topics as the life cycles of plants and animals with emphasis upon flower and seed production, bird migration, animal hibernation, and other adaptations to seasonal change may be brought out. One seasonal phenomenon successfully used by the writer has been that of tracing the life histories of the sporadic fairy shrimps (Dexter 1943b).

The study of community dynamics can best center around observations on food habits and food cycles. Observations can be made directly in the field, and material can be collected for laboratory studies and analyses mentioned below.

Special and detailed observations may be made upon the vegetation or on the population of birds, mammals, fishes, mollusks, insects, etc. Surveys of vegetation and cover-type mapping can be made on field excursions. Competition, fluctuation, and survival of animal populations can be studied over a period of time with periodic quantitative samples. Bird study is particularly suitable and valuable. The more advanced students may assist in bird-banding programs and special censuses such as the Breeding Bird Census and Christmas Bird Count sponsored by the National Audubon Society. Special advantages and methods of bird study are discussed in a paper by the writer (Dexter 1945b). A license is required for bird-banding, mammal trapping, and fish seining, but these are usually available to qualified teachers for educational purposes from the conservation authorities of their states. At certain times of the year, such as after a freshly fallen snow, animal tracking is a fascinating sport.

II. Laboratory Studies

Many ecological problems can be brought into the laboratory for further study and for analysis of the field observations. The establishment and maintenance of aquaria and terraria are common practices which need no further mention here. However, it is well to point out that they should not be mere ornaments but should serve a definite purpose such as studying a microcosm or balanced aquarium, or studying animal behavior and food habits.

Food habits can be studied through the analysis of stomach, pellet, and scat contents. Dead animals collected or brought to the laboratory can be used for stomach analyses in determining food habits of the larger animals. Preserved animals purchased for laboratory dissection can also be used for this purpose. Owl pellets make a very effective demonstration of predation. Scats from birds and mammals can sometimes be used in the same manner if they contain hard, undigestible materials which can be recognized. Otherwise this type of

study becomes too technical for ordinary class study.

Simple gradient experiments can be established for the study of animal reaction in gradients of temperature, light, hydrogen ion concentration, and humidity. The maximum, minimum, and optimum levels of these factors can be determined in a general way.

A simple but very effective demonstration of suspended animation can be shown by soaking in the laboratory a sample of mud from dried-out pools and ponds (Dexter 1946b).

Studies on geographical distribution can be made in the laboratory at times when field work is neither convenient nor possible. Maps of vegetation and of distribution of specific plants and animals should be studied in correlation with climatic and physiographic maps and correlations drawn between the physical environment and the distribution of plants and animals.

III. Social Studies

Recently the viewpoint of ecology has been extended into the fields of the social sciences. Man himself has been the subject of ecological investigation on the part of biologists, geographers, sociologists, and anthropologists. Man and his relationship to environmental factors forms the study of human ecology. The extension of ecological interpretation to include man and his cultural heritage has been pioneered by such men as Sears (1946). Modern man is now being investigated ecologically just as primitive groups have been studied in their relation to the environment and their utilization of natural resources which we know as ethno-ecology. Here is an opportunity for biology teachers to bridge the gap between traditional biological disciplines and the social sciences. Another human aspect of ecology is the practical field of applied ecology generally known as conservation of renewable resources. Much literature has been published on this subject so that it is not necessary to do more than mention it at this time. Finally, the application of ecological principles to problems of health, agriculture, natural resources, and human welfare should show the close interrelationship of all living things, the study of which is the very heart of ecology.

IV. Special Projects

In addition to a general and balanced consideration of ecological principles in the study of biology, advanced students with particular interests should have an opportunity to pursue in greater detail than is possible in class work special projects of an ecological nature. These projects can be an extension or an elaboration of any of the topics mentioned in this paper or especially selected topics. The background of the student, his interest and ability, the natural features available to him for study, as well as time and facilities available must be taken into consideration in organizing a special project. Each one is an individual problem in itself, and great care should be given to its selection in keeping with the total situation as mentioned and the educational ends it is designed to serve.

V. Preparation for the Teacher

As more teachers are convinced of the importance of including ecology in the biology program at all levels of instruction, there will become an increasing demand for training in this field. The need for instruction in ecology at the secondary school level and need for training of biology teachers in ecological science has been felt for some time (Riddle *et al.* 1942). Many colleges have offered courses of study in ecology only

in recent years. Many biology teachers have not received any training in this phase of biology. Summer schools, summer camps, biological stations, and individual initiative can correct this situation. (See current issue of the Turtox handbook on *Biological Field Work*.) Manuals for field and laboratory study which will give the teacher many suggestions have been published by Park, Allee, and Shelford (1939) and Gates (1949). Recent textbooks which have been very successful have been published by Oosting (1948) and Allee *et al.* (1949). These books are intended for college classes in the advanced undergraduate or graduate levels but can be used for reference and background material by the enterprising teacher at lower levels.

The writer has found in his experience that field study does not fit a predetermined pattern which can be universally applied anywhere such as is commonly true of the laboratory sciences. One has to learn to utilize the natural resources available to him to the best advantage. Student evaluation and criticism, especially of the field trips, and newly devised laboratory experiments are of great value in establishing a program of field studies. A questionnaire such as used by the writer (Dexter 1944) for a general criticism of teaching can be adapted for all levels of education and for the special needs of determining the effectiveness of field trips.

In teaching ecology one should direct his efforts toward an understanding of the principles and processes of the interrelationships of living organisms and an appreciation of nature rather than the learning of isolated facts. In developing an ecological point of view the old adage that "one should not lose sight of the forest because of the trees" is literally as well as figuratively true.

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BOOK REVIEWS

HAUROWITZ, FELIX. *Chemistry and Biology of Proteins.* Academic Press Inc., New York, N. Y. xii + 374 pp. illus. 1950. $5.50.

The author's aim has been to integrate chemical, physical and biological data into a unified picture of the nature of proteins, the most important constituents of living matter. In the first part of the book the isolation and analysis of proteins, their amino acid content, and their physical-chemical properties are described. Modern views on the structure of native and denatured proteins are discussed extensively. The second part of the volume contains a description of the biological activities of the important animal and vegetable proteins, including those with enzyme, hormone or immunological activity. The last chapters deal with the mechanism of protein biosynthesis in the living cell.

Inasmuch as proteins compose the indispensable substrate of living matter and that wherever the phenomena of growth and reproduction are seen proteins are primarily involved this is an invaluable book for the biologist. The chapter on isolation, purification and determination of proteins was found especially valuable as was the chapter on albumins and globulins with the practical explanation of the proteins of blood serum, fibrinogen and fibrin, and of muscle proteins. The biologist will welcome the discussion of proteins with enzymatic properties, proteins with hormone activity, proteins in immunological reactions, toxic proteins, all given in readable detail far beyond that found in the usual advanced physiology texts.

CHARLES C. HERBST,
Beverly Hills High School,
Beverly Hills, California

FIELD, HAZEL E. and MARY E. TAYLOR. *An Atlas of Cat Anatomy.* The University of Chicago Press, Chicago, Ill. 75 pp. 57 plates. Spiral bound. 1950. $3.75.

This atlas of cat anatomy is designed to be a visual teaching aid to both student and teacher. There are 57 concise plates showing basic parts but not stressing a great many details. The page size is $10 \times 12\frac{1}{2}$ inches, thus the plates and text are easily read. When the book is open the left hand page carries a bleed plate showing all anatomical structures of a given area of the cat with an accompanying key to numbered parts. In the upper left hand corner of the page is an outline drawing of a standing cat with all areas shaded, excepting those which occur in the plate on that page. Nearly all plates are made from photographs of actual dissections. On the right hand page is a very brief description of the general area of the cat under study in the plate on the left hand

ANNUAL JOINT FIELD TRIP

Sunday, December 30

8:00 A.M. Joint Field Trip, NABT and ANSS.

8:00 A.M. Chestnut Street Entrance, Adelphia Hotel, 13th and Chestnut Sts. *Departure of Field Trip.* Jointly sponsored by the American Nature Study Society and the National Association of Biology Teachers. (Cost per person $4.00, including transportation by bus and a box lunch. Reservations must be in by Friday, December 28. This will be a trip to the Pine Barrens of New Jersey and the Atlantic Coast. Open to all interested individuals.)

Leaders: Joseph M. Cadbury, James A. Fowler, Louis E. Hand, E. Laurence Palmer, Roger Tory Peterson, and Edgar T. Wherry.

page. Wherever a difficult word appears for the first time, its phonetic pronunciation is given.

There is a glossary and an index. The glossary includes pronunciations, synonymous terms, derivations, and definitions. This book will prove to be very helpful to the student who wants to quickly identify structures; it will be useless, however, in presenting details. A weakness of the book is that in about 50% of the plates the cat is facing the reader and in the rest the cat faces away from the reader. Thus the reader must keep reversing his cat's position to keep it in proper relation to the plate.

TED F. ANDREWS,
State Teachers College,
Emporia, Kansas

NORDRUM, GARFIELD B., *Conservation—Soil and Water*. Department of Public Instruction, State of North Dakota, 1948.

This paper bound book was evidently issued for use in the public schools of North Dakota. While some of its basic principles would be useable in any classroom situation it would seem to be useable mainly by children of rural background.

The organization of the book could be improved and the content condensed. For use at the elementary school level, as the classroom activities suggest, I believe the number of pictures should be reduced and none of the cartoon type illustrations used. Some of the pictures were not clear both as to photography and purpose.

Despite these objections it is a very commendable effort to put the study of conservation and its practices into the educational picture of the state. It should be of value to 4-H groups and conservation clubs as well as to the classroom.

O. D. ROBERTS,
The University of Oklahoma,
Norman, Oklahoma

FILMSTRIPS

Following its policy of producing filmstrips for curriculum areas not before reached by this medium, the Audio-Visual Division of Popular Science Publishing Company, 353 Fourth Avenue, New York has just announced release of several new filmstrip productions.

Three of the new productions are individual black-and-white, full-length filmstrips on current science: "Pulleys Make Work Easier", "What Is Horsepower?" and "What Is Soil?" All three are based on actual articles that appeared in very recent issues of *Popular Science Monthly*, thus linking established science curricula to latest developments in science and industry. All three are designed for General Science classes in grades 7 through 9. A fully illustrated, 6-page Teaching Guide comes with each strip.

Among the new filmstrip series is an unusual trailblazer, *General Livestock and Dairy Judging*, first filmstrip series of its kind ever produced. Intended for use by Agricultural schools, County Agents, 4H groups, Granges, Future Farmers of America and other farm organizations, this series was made by Popular Science in cooperation with the United States Department of Agriculture and the Animal Husbandry Departments of Mississippi State College and Kentucky State University. *General Livestock and Dairy Judging* is a completely functional approach to the entire subject of management of successful livestock enterprises and better livestock farming. In full color, the five strips total 185 frames and are titled: "Breeds of Beef Cattle", "Judging Beef Steers", "Judging Barrows", "Judging Sheep" and "Judging Dairy Cattle". A Teaching Guide accompanies this unusual series.

Rounding up the list of new releases is *Food Around the World*, five filmstrips developed in cooperation with the World Book Encyclopedia. The 255 frames cover the subjects of food in history; effect of science and invention on food growing and processing; geographic distribution of foods we eat; diet; food habits and customs around the world. Four of the strips are in black-and-white; one in full color. A fully illustrated Teaching Guide comes with *Food Around the World*.

All the filmstrips and filmstrip series are

available for immediate delivery at the following prices: *Pulleys Make Work Easier*, *What Is Horsepower?* and *What Is Soil?*, $3.50 each; *Food Around the World*, a total of five strips—four in black-and-white and one in color—$19.50; *General Livestock and Dairy Judging*, a series of five color strips, $35.00. Teaching Guides included at no extra charge with each individual filmstrip or filmstrip series. For further information, contact the Audio-Visual Division of Popular Science Publishing Company, 353 4th Avenue, New York 10, New York, or your local Audio-Visual dealer.

TENSIONS

"A gnawing sensation in the pit of your stomach, which you may describe as hunger, may be due to emotional tension," Dr. Bella S. Van Bark, psychiatrist and faculty member of the American Institute for Psychoanalysis, told the Cooper Union Forum recently.

There are healthy normal tensions, Dr. Van Bark pointed out, which are followed by real satisfaction when relieved, as in the case of relief from the tension of hunger.

"Abnormal tensions may be experienced by the individual as 'jitteriness,' 'shakiness,' uneasiness, nervousness, and vague discomfort. Often he may have headaches or a stomach ache. Or such individuals often have a gnawing sensation, a feeling of emptiness in the stomach like hunger. Not even the largest meal or the richest sundae can do more than temporarily still the inner tension, and there is no resultant real satisfaction. The causes for this kind of 'hunger' are deep-seated.

"When, in the course of trying to take care of himself and get along, an individual needs to evolve a false picture of what he really believes, wants, needs, feels and thinks he inevitably loses sight of and turns against his own real urges for self-expression, self-assertion and self-development in a natural and spontaneous way. In dealing with himself, and in the impact of people in daily living and on a larger scale, he experiences tension much more frequently than the individual who is capable of greater honesty and reality about himself.

"The less healthy individual has to force himself and mold himself to fit into and to maintain the false picture. When he fails to do so, or when people fail to meet his unconsciously or consciously expressed requirements, he becomes filled with tension from feelings of anxiety, frustration, resentment varied fears, suspicion, revenge, rage, self-recrimination, self-accusations, guilt feelings and other emotional responses. Tension also is generated by hurt pride, inner conflicts, hyper-sensitivity, envy, pervasive dissatisfaction and feelings of weakness and helplessness. A great deal of tension is generated when the individual attempts to be himself and has to struggle against the forces of the false self.

"In the various attempts to relieve the unhealthy and troublesome tensions, the underlying causes remain unchanged. This creates even more dissatisfaction and tension. Some of the most common ways in which people attempt to gain inner peace are: the search for love, the search for power, and the attempt to sustain themselves in a relative state of inertia.

"There are plenty of external sources for tension. These can be handled more effectively by the person who has achieved some inner strength and reduced the sources of tension coming from his own character structure."

CIDER AND PICKLES

may be only a strange combination of food to some people, but to members of the National Scientific Honor Society at Bloomington (Indiana) High School, they are a ticket to Chicago.

Desiring to visit the Chicago planetarium in May and having a rather inflexible club treasury, the members decided to earn the necessary money by selling cider at home football games and sweet, sour, and dill pickles at the basketball games.

The money-making project was tried out last year and netted enough to finance a club trip to Mammoth Cave in Kentucky.

These field trips, however, are not without preparation; last year each program of the club, which meets bi-weekly, was devoted to the study of caves, and the group project was the construction of a model cave complete with clay stalactites and stalagmites.

This year's theme is astronomy, and both group and individual projects concern this subject. Already the club has visited the observatories at Indiana University (at Bloomington) and at Martinsville, approximately 30 miles distant.

Last year one member, Judith Douthitt, was named "The Most Scientific Girl in Indiana" at a Junior Academy of Science meeting at Greencastle. The honor was given her for a display of her individual project, a collection of handmade lantern slides.

Founded eighteen years ago by the late Mr. Milton Williams, science teacher and club sponsor for fifteen years, the National Scientific Honor Society is now under the guidance of Mr. Harold Stewart who has formulated but one purpose for the organization: to further the interests of science at BHS.

The club, which attempts to encourage young people in the field of science, is open to any interested student who has maintained a "B" average in all science courses and a satisfactory citizenship grade throughout his high school career. In addition, each candidate for membership must submit a research paper on the club's scientific theme for the following year. Those students accepted for membership are initiated in the semi-annual ceremony which incorporates the seriousness of the club's ideals.

Future scientists, the members of the BHS chapter of National Scientific Honor Society are getting valuable experience today for a career tomorrow.

HAROLD STEWART, *sponsor*
CHARLES SWAYNE, *president*

PHILADELPHIA MEETING—(*Continued from page 158*)

2:00 P.M. Jefferson Room, Adelphia Hotel. Conservation Education Workshop.
Richard L. Weaver, Presiding.
Consideration of Good Practices in Teaching Conservation in Biology.
Reports of Successful Programs.
Development of Plans for Conservation Project.

8:00 P.M. Coral Lotus Room, Adelphia Hotel. Meeting of NABT Conservation Committee, Executive Committee, Regional and State Chairmen.

Saturday Morning, December 29

8:00 A.M. Junior Room, Adelphia Hotel, Meeting of Membership Committee
and
Meeting of Editorial Board of The American Biology Teacher.

9:00 A.M. Crystal Room, Adelphia Hotel, Preview of Science Films, Arranged by NSTA.

10:00 A.M. Crystal Room, Adelphia Joint Session arranged by NSTA.

Saturday Afternoon, December 29

2:00 P.M. Jefferson Room, Hotel Adelphia.
Harvey E. Stork, Presiding.

1. Martin L. Grant. How the Teacher's Literature Files Can Serve the Students in Laboratory and Classroom Work.
2. B. Bernarr Vance. Experimental and Laboratory Techniques.
3. Leo F. Hadsall. Teaching Combinations of California High School Biology Teachers
4. Walter F. Taylor. The Biology Teacher's Responsibility to Society.
5. John Breukelman. The Biology Teacher and *The American Biology Teacher*.

THE STAFF

In order that readers may know who carries the chief responsibilities in the activities of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS and *The American Biology Teacher* it is the policy of the journal to publish twice a year, in the November and February issues, a complete list of the staff members. Lists of chairmen and personnel of committees are published in connection with reports of their activities.

All these individuals are deeply interested in the improvement of both the association and the journal. They welcome suggestions from members and are ready to give assistance to anyone interested in writing items or other articles for the journal.

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Manuscripts for publication in THE AMERICAN BIOLOGY TEACHER should be typewritten, on one side only, on standard white paper, $8\frac{1}{2} \times 11$ inch size, with a margin of at least an inch on all sides. The writer should keep a carbon copy for reference and as insurance against loss of the original in transit.

Articles are scheduled for publication in approximately the order of acceptance of the manuscripts. Generally the journal is tentatively arranged about three or four issues ahead, and there are under consideration at any time enough manuscripts for about two or three more issues. Some space is of course allowed for news items and articles of a seasonal nature. Many seasonal papers have to be postponed an entire year, simply because the author has not allowed the necessary four to six months that intervenes between acceptance and publication.

For details concerning titling, headings, references, illustration, etc., consult *Preparation of Manuscripts for Publication*, which appeared in the November, 1949, issue of THE AMERICAN BIOLOGY TEACHER. A limited number of reprints is available; copies may be obtained from the editor or from the Secretary-Treasurer.

Manuscripts may be sent to the editor-in-chief, assistant editor, or to any one of the associate editors. A complete list of the latter appears in each November and March issue.